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Pacific Region
Canadian Science Advisory Secretariat
Science Advisory Report 2011/074

RECOMMENDATIONS FOR CULTUS PYGMY SCULPIN CRITICAL HABITAT

Cultus Pygmy Sculpin (Photo credit: Sylvia Letay)

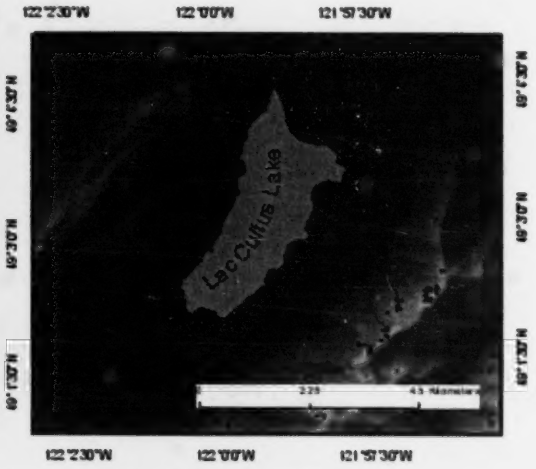

Figure 1: Cultus Lake near Chilliwack BC.

Context:

Since April 2003 the Cultus Pygmy Sculpin has been listed as a threatened species under the Species at Risk Act (SARA). As such, critical habitat for the species must be identified in the Recovery Strategy or Action Plan based on the best information possible. Once identified provisions of SARA and/or other federal legislations protect critical habitat from destruction.

Advice was requested by Species At Risk program staff to review the best available information that would lead to recommendations for the identification of critical habitat for Cultus Pygmy Sculpin.

This Science Advisory Report has resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Pacific Regional Advisory Meeting. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfompo.gc.ca/csas-sccs/index-eng.htm.

SUMMARY

- Cultus Pygmy Sculpin (*Cottus aleuticus)* is a sub-population of the commonly found Coastrange sculpin and is only found in Cultus Lake, near Chilliwack, British Columbia
- Cultus Pygmy Sculpin is listed under the *Species At Risk Act* as threatened. Critical habitat must be identified for threatened and endangered Species.
- Critical habitat is recommended as the entire wetted area of Cultus Lake.

- The features of the recommended critical habitat are the benthic environment and the water column of the lake. The functions supported by critical habitat are spawning, feeding, rearing and predator refuge.
- Activities likely to destroy critical habitat include: excessive nutrient inputs and deliberate or inadvertent introduction of aquatic invasive species
- Further research is recommended on temporal and spatial use of the lake by Cultus Pygmy Sculpin, including the littoral zone. Also, the impacts of Eurasian watermilfoil (*Myriophyllum spicatum*) and its possible control measures should be assessed.

INTRODUCTION AND BACKGROUND

The Species At Risk Act (SARA) recognizes that a species' critical habitat is necessary for its survival and recovery. Every Recovery Strategy or Action Plan developed for a species listed on SARA as threatened or endangered must identify critical habitat to the extent possible, using best available information.

Critical Habitat is defined under SARA as:

"...the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species."

Critical habitat functions, biophysical features and attributes should be clearly delineated as integral components of a critical habitat identification process. Furthermore, recovery goal(s) as described in the Recovery Strategy document should be central to identifying a species' critical habitat. In other words, SARA critical habitat identification is directly based on the recovery goal(s) of the SARA listed species. As well, the identification process is inherently an iterative approach that is only complete when the recovery goal is achieved.

The recovery goal of the Cultus Pygmy Sculpin, is
"... to ensure the long-term viability of the population in the wild. This taxon is likely to remain at an elevated risk due to the population's extremely limited distribution." (NRCTCPS 2007)

When critical habitat is identified, examples of Activities Likely to Destroy Critical Habitat should also be provided per requirements from SARA. This serves to establish a baseline to identify and communicate to the Canadian public the kind of activities that are likely to lead to critical habitat destruction.

This document recommends critical habitat for Cultus Pygmy Sculpin to the extent possible based on best available information. As well, it provides examples of activities likely to destroy Critical Habitat.

General Description

The Coastrange Sculpin (*Cottus aleuticus*) is found in coastal watersheds of western North America from Bristol Bay in Alaska to San Luis Obispo, California (Scott and Crossman 1973). It is commonly found in riffles of rivers and streams along the entire coastline of British Columbia. Except in a few large river systems such, as the Fraser and Skeena Rivers, it is typically restricted to within about 100 km of the coast (McPhail 2007). Unlike the stream dwelling form of *C. aleuticus*, Cultus Pygmy Sculpin are found throughout the water column and

in deep areas (up to 40m), including the benthic zone (Ricker 1960, Woodruff 2010). The Cultus Pygmy Sculpin is endemic to Cultus Lake and, therefore found no where else in the world.

The general appearance of the Cultus Pygmy Sculpin is very similar to that of the Coastrange Sculpin. As is the case with all sculpins, *C. aleuticus* has morphological features adapted to a bottom dwelling lifestyle, and lacks a swim bladder (McPhail 2007, Scott and Crossman 1973). The Cultus Pygmy Sculpin differs from the more typical *C. aleuticus,* in that it appears to be a dwarf form, maturing at a smaller size (maximum total length = 49-65mm) in the lake's pelagic environment (McPhail 2007, Cannings 1993, Scott and Crossman 1973, Ricker 1960, Woodruff 2010).

Little is known about the biology and habitat preferences of the Cultus Pygmy Sculpin; to-date nearly all of the research conducted on this species has been documented by Ricker (1960) and Woodruff (2010).

Life History

Typical *C. aleuticus* young become planktonic in lakes or estuaries after hatching and then take up a benthic lifestyle approximately one month later. Juveniles make their way back into the streams and mature at a maximum total length of 115mm (Ricker 1960, Scott and Crossman 1973). In contrast, juvenile Cultus Pygmy Sculpin do not migrate after hatching, and are adapted to complete their entire life cycle in the deep offshore waters of Cultus Lake (Ricker 1960).

Cultus Pygmy Sculpin spawning (probably) takes place from late May to early September (Ricker 1960). Fecundity in the Coastrange Sculpin is a function of female body size. Cultus Pygmy Sculpin females mature as small at 37mm and therefore probably have relatively low fecundity, between 50 – 150 eggs (McPhail 2007).

While the spawning habitat of the Cultus Pygmy Sculpin is unknown, another lacustrine sculpin species, *C.extensus,* has been found to use rocky, cobble or boulder substrate (Ruzycki et al. 1998). *C. aleuticus* found in coastal streams use gravel riffles for spawning areas (Ricker 1960). It is reasonable to infer that Cultus Pigmy Sculpin spawning habitat is likely to be similar to other lacustrine sculpin species i.e. rough substrates such as gravel, cobbles or boulders.

Behaviour

Some sculpins have cryptic colourations and typically avoid predators by reducing their movements and instead, rely on crypsis as defence. Woodruff (2010) found that in contrast to a typical cryptic response, Cultus Pygmy Sculpin tend to ascend into the water column when a known predator, Prickly Sculpin (*C. asper*), was present. As *C. asper* is a larger sculpin, it is also likely to out-compete Cultus Pygmy Sculpin for any refuge on the bottom (McNeely et al. 1990). Woodruff (2010) suggests that predation and/or competition from *C. asper* in Cultus Lake may have been an important factor in the evolution of the limnetic life history of the Cultus Pygmy Sculpin.

General Habitat Use

Cultus Pygmy Sculpin have not been observed in surveys along the shores of Cultus Lake or in its tributary streams (Ricker 1960; Woodruff 2010). Significant Cultus Pygmy Sculpin numbers however, have been observed in the stomachs of Bull Trout (*Salvelinus confluentus*) that forage in the deep, offshore waters of the lake (Ricker 1960) as well as in minnow traps suspended in the pelagic zone (Woodruff 2010). Cultus Pygmy Sculpin have also been incidentally captured

in pelagic trawl surveys targeting Sockeye Salmon (*Oncorhynchus nerka*) in Cultus Lake (COSEWIC 2010). Woodruff (2010) concluded that Cultus Pygmy Sculpin primarily occupy the deeper (>20m), offshore waters of the lake. Most fish captured in Woodruff's (2010) offshore minnow trapping efforts were observed in traps set either on the bottom or within 10m of the bottom. Cultus Pygmy Sculpin have been caught in trawls as shallow as 4m on occasion. All capture data to-date (Woodruff 2010, Ricker 1960) are consistent with McPhail (2007), who suggests that Cultus Pygmy Sculpin undertake diel vertical migrations.

Seasonal trends are also shown by information from efforts of Woodruff (2010) and Ricker (1960), as well as historical trawl by-catch data (COSEWIC 2010). Woodruff (2010) captured Cultus Pygmy Sculpin during every month from May to October, with the highest catches occurring in July and August. Average depth of capture in July and Aug are slightly shallower than other months. This trend is confirmed by the historical trawl by-catch dataset that indicates average capture depths as shallow as ~10m to ~20m in summer months (May to Aug). Note that depth values from the by-catch datasets are based on the centre of the trawl net, and may overlap with each trawl tow. Also, depth selection is not random as it is specific to the juvenile Sockeye salmon distribution. Both datasets from Woodruff (2010) and the historical Sockeye salmon survey trawls indicate the smallest individuals are found in summer months between June to August. These smaller individuals are most likely to be young-of-the-year.

Typical *C. aleuticus* are not known to occupy sandy substrate, preferring instead coarse gravel and cobble substrate for foraging (McPhail 2007; Tabor et al. 2007). Substrate preference is not known for Cultus Pygmy Sculpin specifically, although it is reasonable to expect that these fish also prefer similar substrate types such as coarse gravel and cobble.

Prey

The main prey items of the Cultus Pygmy Sculpin are the cladoceran zooplankton, particularly *Daphnia* which are abundant year round in the lake (COSEWIC 2010). Ricker (1960) found that the diet of the Cultus Pygmy Sculpin consists of *Daphnia*, Chironomid midges, *Epischura*, ostracoda, *Bosmina* and Cyclops, with *Daphnia* being the most favoured. According to Shortreed (2007), *Daphnia* biomass in Cultus Lake constitutes 72% of total plankton; as well, they are generally found in highest density in the vicinity of the thermocline (metalimnion) at night.

ASSESSMENT

Approach to Identifying Critical Habitat

The identification of critical habitat in the context of SARA must:

a) Specify the geospatial location of the Critical Habitat or describe the area within which Critical Habitat is found; and

b) Describe the known biophysical functions, features and attributes of that Critical Habitat that are required by the listed wildlife species in order to carry out life processes necessary for its survival or recovery.

A biophysical function is a characteristic of critical habitat that corresponds to a biological need or life-process requirement of the listed species. A function describes how the critical habitat is used by a listed species to support a life process and informs the rationale for its protection. This protection should in turn support the species recovery and survival.

A critical habitat feature may support more than one biophysical function; e.g. a riffle habitat may be used for spawning and rearing function for a species. In addition to supporting a particular function, some features may also support or reinforce other features and their associated attributes. Features may change over time and a change or disruption to a feature may affect its function and ability to meet the biological needs of a species. For example, a feature such as a riffle may not be static over time and may in fact be lost entirely as a result of natural processes. Every feature is comprised of attributes such as temperature, water depth, velocity and oxygen levels. Together, attributes perform the functions necessary for sustaining life-processes of a listed species.

In other words, for a successful protection of the SARA listed species, every critical habitat function and its associated features and attributes should be identified to the extent possible, based on best available information.

Through a technical workshop that took place in February 2011, inputs from experts from the University of British Columbia, Fisheries and Oceans Canada (Cultus Lake Salmon Research Laboratory, Pacific Biological Station, and Pacific Region headquarters), Environment Canada, British Columbia Parks and the British Columbia Ministry of Natural Resource Operations were incorporated as a foundation to this identification work.

Critical habitat: Geospatial Features

The distribution of the Cultus Pygmy Sculpin is restricted to Cultus Lake in southwestern British Columbia. Located approximately 10 km south of the City of Chilliwack, in the eastern Fraser Valley, Cultus Lake is a small lake with a surface area of 6.3 km^2. The lake has a littoral zone area of approximately 0.9 km^2, a mean depth of 31 m, and a maximum depth of 44 m (Shortreed 2007).

There is no evidence to support the hypothesis that the geographic range of Cultus Pygmy Sculpin exceeds the wetted boundaries of Cultus Lake. For the past 30 years, DFO has conducted mid-water trawl surveys on a vast number of B.C. lakes containing anadromous Sockeye Salmon. The majority of the lakes contain no Sculpins, and for those lakes that do, the by-catches have been generally identified to be too large to be pygmy forms of Coastrange Sculpin (COSEWIC 2010; Woodruff 2010). It is reasonable to infer that Cultus Lake supports all essential life functions of this species. Therefore, the geospatial extent of the critical habitat for Cultus Pygmy Sculpin is recommended to be the entirety of Cultus Lake up to the wetted boundary (Fig. 1).

Critical habitat: Biophysical Functions, Features and their Attributes

As indicated previously, the concept of habitat function and the associated features and attributes form integral components of the critical habitat identification process, in the context of SARA. It is reasonable to assume that Cultus Lake has historically provided all essential functions for the Cultus Pygmy Sculpin to evolve and thrive. The following table shows the critical habitat function, features and attributes for Cultus Pygmy Sculpin.

Table 1 *Biophysical Functions, Features, and Attributes of critical habitat for the Cultus Pygmy Sculpin.*

Function	***Feature(s)***	***Attribute(s)***
Spawning	Benthic environment (inferred)	Benthic substrate size – Coarse substrates such as cobble or gravel. Oxic benthic condition
Rearing	Benthic environment (inferred)	Benthic substrate size – Coarse substrates such as cobble or gravel. Oxic benthic condition
	Water column (inferred)	Lake water quality that maintains the structural and functional lake ecosystem characteristics necessary for the persistence of Cultus Pygmy Sculpin Water clarity sufficient to retain the deep euphotic zone of Cultus Lake. Prey availability.
Feeding	Water column (observed)	Lake water quality that maintains the structural and functional lake ecosystem characteristics necessary for the persistence of Cultus Pygmy Sculpin Water clarity sufficient to retain the deep euphotic zone of Cultus Lake. Prey availability.
Predator Refuge	Water column (inferred)	Unknown but water clarity may play an important role.

Examples of activities likely to result in the destruction of Critical Habitat

Table 2. *Examples of activities likely to result in the destruction of the critical habitat of the Cultus Pygmy Sculpin.*

Activity	Effect Pathway	Function Affected	Feature(s) Affected	Attribute Affected
Excessive nutrient inputs to Cultus Lake through groundwater and/or surface flows as the result of non-point sources such as residential septic seepage.	Eutrophication causing algal blooms in the lake leads to reduced light penetration and water clarity, oxygen depletion, changes in water chemistry and increased sedimentation rates; altered food web structure for CPS, and the possibility of shallowing of the summer euphotic zone to within the warm epilimnion	Spawning Rearing Feeding	Water Column Benthic Substrate	Lake water quality Depth of euphotic zone and water clarity Coarseness of benthic substrate Prey availability Forage efficiency Lower oxygen concentrations at depth
Excessive nutrient input to Cultus Lake through groundwater and/or surface flows, as the result of over-application of fertilizers in agricultural lands and golf courses, as well as residential lawns in the watershed.	Eutrophication causing algal blooms in the lake lead to reduced light penetration, water clarity, oxygen depletion, change in water chemistry and increased sedimentation rates; altered food web structure for CPS, and possibly shallowing of the summer euphotic zone to within the warm epilimnion	Spawning Rearing Feeding	Water Column Benthic Substrate	Lake water quality Depth of euphotic zone and water clarity Coarseness of benthic substrate Prey availability Lower oxygen concentrations at depth
Introduction of invasive species through deliberate or inadvertent human actions.	Pathways such as recreational water crafts carrying invasive species into Cultus Lake can dramatically modify the lake ecosystem. This in turn may cause any or all of the following effects: changes in the lake nutrient cycling, modification of predator-prey relationships, changing zooplankton community composition and lake water quality.	Rearing Feeding	Water Column	Lake water quality Depth of euphotic zone and water clarity Prey availability. Lack of predator refuge

Sources Of Uncertainty

The exact location of spawning is unknown. Spawning may take place within the lake (i.e. littoral area) or within tributaries. The role of the water column as a predator refuge may be affected by the introduction of an invasive species, but the degree of impact has not been quantified. The impact of Eurasian watermilfoil and its management is unknown.

CONCLUSIONS

Based on the best available information the entire wetted area of Cultus Lake is recommended as critical habitat for Cultus Pygmy Sculpin. The introduction of invasive species and excessive nutrients to Cultus Lake may have a deleterious effect on Cultus Pygmy Sculpin. Further work could be undertaken to determine the spatial and temporal distribution of the different life stages of Cultus Pygmy Sculpin in the lake and to assess if and how the lake tributaries are used.

SOURCES OF INFORMATION

This Science Advisory Report has resulted from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Pacific Regional Advisory Meeting of October 12th, 2011 Cultus Pygmy Sculpin Critical Habitat. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

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ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)
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La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2012. Recommendations for Cultus Pygmy Sculpin Critical Habitat. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/074.